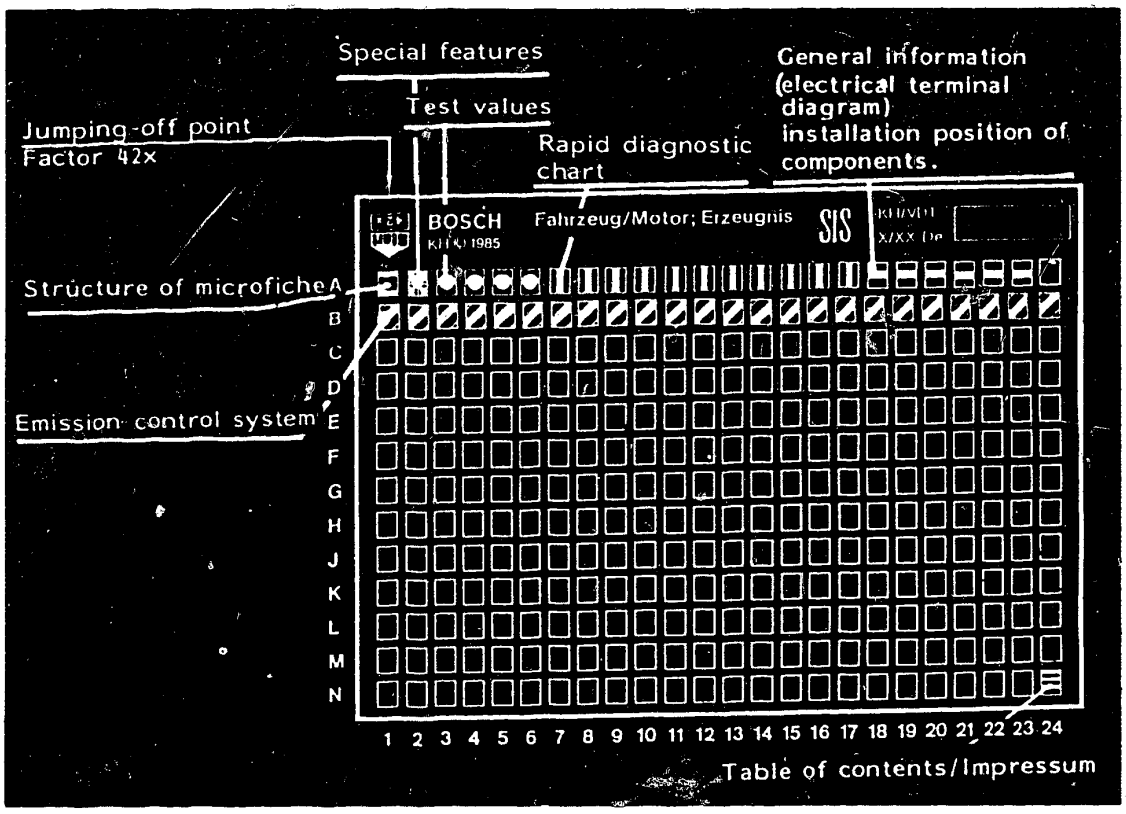
Structure of microfiche



1. Read from left to right

2. Title of microfiche (appears on each coordinate)

E16	Product/component/test step Vehicle/engine

Coordinate

3. Limits of section

Beginning | Mid-section | End | One-page section

4. Purely vehicle-specific passages in the text are marked with a vertical bar.

1. Special features

For MB 190 E, Sweden/Switzerland versions, 8.83 →

1.1 New electronic engine-speed relay with the following functions:

- Energization of electric fuel pump.
- Energization of start valve as a function of battery voltage, coolant temperature, starting signal. On-time e.g. at -20°C approx. 10s, or correspondingly shorter in case of shorter cranking time.
  Not operative at above approx. +60°C. There is no thermo-time switch.
- Engine-speed limitation through fuel cutoff is dropped. (Engine-speed limitation through ignition cutoff).

1.2 Temperature sensor with double connector(double NTC). The two leads can be connected either way round.

1.3 Throttle-valve switch on vacuum-control valve near throttle-valve assembly for detection of idle and full load.

1.4 Emission-control system (exhaust-gas recirculation, secondary-air self-induction) (not made by Bosch).
The influence of the emission-control system should be taken into account when performing trouble-shooting on the mixture-preparation system.
Description and trouble-shooting notes on non-Bosch systems in SIS brief instructions starting on B 1.

Note:

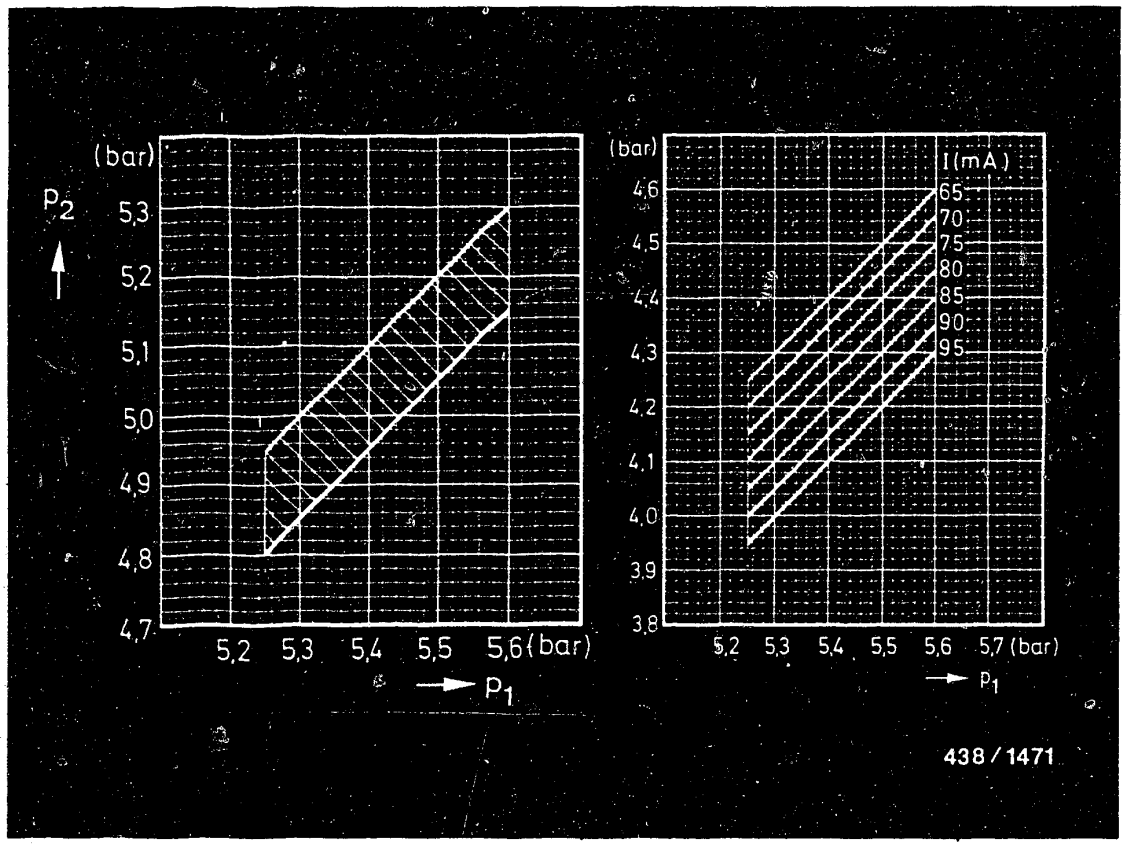
Basic microcard for detailed trouble-shooting: MB-501

Important: If referring to a basic microcard, remember that the test specifications must always be taken from the vehicle-related brief instructions.

2. Test specifications

Test step	Test specifications*
2.1 Electric fuel pump:	
Fuel delivery:	min. 1100 cm^3/min.
2.2 Fuel pressures:	
Primary pressure:	5.25 ... 5.6 bar 5.35 ... 5.7 kp/cm^2

* Pressures in the test-specification table are given in bar (gauge pressure) and in kgf/cm^2 (gauge pressure)



P_1 = Primary pressure

P_2 = Lower chamber pressure

● Differential pressure:
(Primary pressure/lower chamber pressure)

Take the "warm" lower chamber pressure specification from the left-hand graph in accordance with the measured primary pressure. Actuator current 0 mA.

Take "cold" lower-chamber pressure specification from the right-hand graph in accordance with the measured primary pressure and in accordance with the measured actuator current.
Note: Tolerance ± 0.15 bar
The "cold" condition is simulated by disconnecting the plug from the temperature sensor (NTC).

Test step	Test specifications *

2.3 Leak test on overall fuel system

Minimum pressure	
after 10 minutes:	2.7 bar (2.8 kgf/cm²)
after 20 minutes:	2.6 bar (2.7 kgf/cm²)

2.4 Injection valves

Opening pressure	3.0 ... 4.1 bar (3.1...4.2 kgf/cm²)

2.5 Fuel distributor test

(Test with pressure actuator mounted. Pressure actuator at zero current)

Comparative measurement of deliveries from outlets:	Setting point	Max. allowable delivery
Idle	6.0 cm³/min.	6.6 cm³/min.
Part load	40.0 cm³/min.	42.5 cm³/min.
Full load	100.0 cm³/min.	109.0 cm³/min.

Full-load delivery with maximum deflection of air-flow sensor plate, measured with measuring glass at outlet with the lowest delivery at full-load measuring point: min. 140 cm³/min.

Flow rate of KE throttle in fuel distributor:	130...145 cm³/min.

* Pressures in the test specifications are given in bar (gauge pressure) and in kgf/cm² (gauge pressure).

Test step	Test specifications
2.6 Temperature sensor Resistance measurements: Engine cold. Ambient temperature (+15°C...+30°C): Engine at normal operating temperature (approx. +80°C):	 1300...3600 Ω 250... 390 Ω
2.7 Air-flow sensor potentiometer: Voltage signal with sensor plate in basic position:	 0.2...0.3 V
2.8 Idle-mixture-adjusting screw Basic setting dimension: (Fuel-distributor support surface - needle bearing):	 21.1...21.3 mm
2.9 Auxiliary-air device Resistance of heating winding:	 30...65 Ω
2.10 Idle adjustment Idle speed: Idle exhaust-gas setting (CO): (Secondary-air self-induction operative)	 750...850 min^{-1} 0.4...1.2 vol.%

3. Rapid diagnosis chart for universal test adapter ETT 018.01 with KE-Jetronic test lead 1 684 463 135 and suitable multimeter

The following rapid diagnosis chart makes it possible for the experienced Jetronic expert to quickly check the electrical/electronic peripheral and control-unit functions of the KE-Jetronic.

Important notes on the following rapid diagnosis chart:

The "Test conditions" column shows for which test steps the control-unit plug must be connected or disconnected. Make absolutely sure that the ignition is off whenever connecting or disconnecting the control-unit plug.

The "Test connections" column provides information on the leads connected into the respective test circuit, referenced to the pin assignment in the control-unit plug.
Trouble-shooting, if necessary, refers to these leads.

In the following test chart, functions and components of the exhaust-gas recirculation system (EGR) are checked in addition to the peripheral and control-unit functions of the KE-Jetronic.
Test steps 1 to 6, required for this, cannot be performed with the universal test adapter. The "Test conditions" column states the procedure for these test steps (connection of measuring equipment etc).

Rapid diagnosis chart for universal test adapter ETT 018.01

Test Step	Switch Position V	Switch Position Ω	Button	Under Test	Test Connections	Test Conditions	Test Specifications (Reading)
1	-	-	-	Throttle-valve switch - idle		Ignition off. Take apart triple plug (near mixture-control unit) between throttle-valve switch and EGR control unit. Connection of ohmmeter at pins 1 and 2. Throttle valve closed:	0 ... 1 Ω
				- full load		Connection of ohmmeter at pins 2 and 3. Throttle valve wide open:	0 ... 1 Ω
2	-	-	-	Power supply to EGR control unit		Disconnect EGR control unit. Connection of voltmeter: Positive = socket 9 in base Ground = socket 11 in base Switch on ignition. Voltage reading:	8 ... 15 V
3	-	-	-	Cable set to solenoid-operated valve (EGR)		EGR control unit disconnected. Connect sockets 9 and 3 in base. Disconnect coupling from solenoid-operated valve (EGR). Connect voltmeter to coupling. Switch on ignition. Voltage reading:	8 ... 15 V
4	-	-	-	Cable set to throttle-valve switch - idle		EGR control unit disconnected. Connection of voltmeter Positive = socket 10 in base Ground = socket 11 in base Switch on ignition. Throttle valve closed:	8 ... 15 V

Test Step	Switch Position V	Switch Position Ω	Button	Under Test	Test Connections	Test Conditions	Test Specifications (Reading)
5	-	-	-	Cable set to throttle-valve switch - full load		EGR control unit disconnected. Connection of voltmeter Positive = socket 8 in base Ground = socket 11 in base Switch on ignition. Throttle valve wide open:	 8 ... 15 V
6	-	-	-	Operational check of EGR control unit		Connect EGR control unit. Disconnect coupling from solenoid-operated valve (EGR). Connect voltmeter to coupling. Switch on ignition. Throttle valve closed: Throttle valve slightly open: Throttle valve wide open:	 8 ... 15 V 0 V 8 ... 15 V
7		4	-	Pressure actuator internal resistance	12 - 10	Disconnect control-unit plug.	20 ... 30 Ω
8		5	-	Temperature sensor internal resistance +15°C ... +30°C: approx. 80°C	21 - 2	Control-unit plug disconnected.	 1.3...3.6 kΩ 250...390 Ω
9		9	-	Microswitch - idle (on throttle linkage)	13 - 6	Control-unit plug disconnected. Throttle valve closed. Open throttle valve by hand.	 0 ... 10 Ω ∞ Ω

Rapid diagnosis chart for universal test adapter ETT 018.01

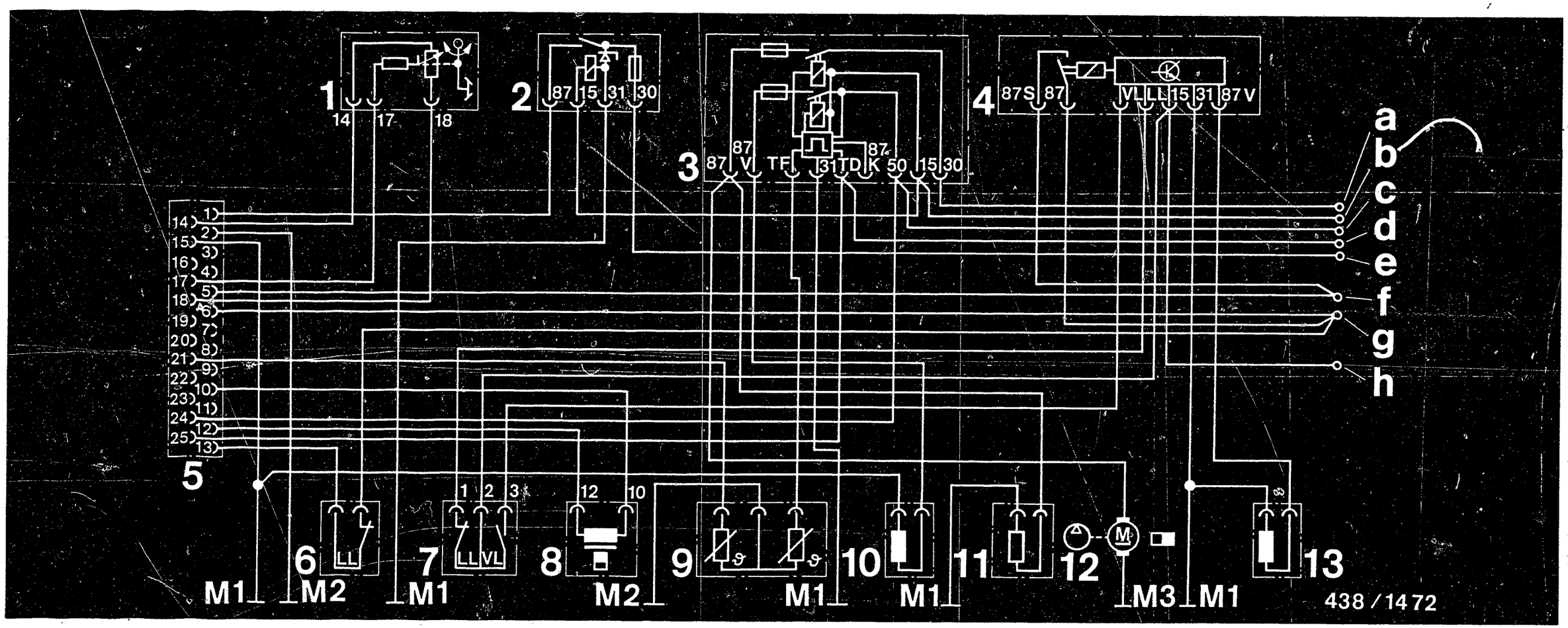
Test Step	Switch Position V	Switch Position Ω	Button	Under Test	Test Connections	Test Conditions	Test Specifications (Reading)
10		10	-	Full-load contact (in EGR control unit)	5 - 6	Control-unit plug disconnected. Switch on ignition. Throttle valve closed. Throttle valve wide open.	 ∝ Ω 0 ... 10 Ω
11	4	-	-	Starting signal	24 - 2	Control-unit plug disconnected. Operate starting motor.	8 ... 15 V
12	5	-	-	TD signal	25 - 2	Control-unit plug disconnected. Operate starting motor for a few seconds.	Undefined voltage
13	6	-	-	Control unit power supply	1 - 2	Control-unit plug disconnected. Switch on ignition.	8 ... 15 V
14	7	-	-	Air-flow sensor potentiometer power supply	18 - 2	Switch off ignition. Connect control unit. Switch on ignition.	7.0...8.0 V
15	8	-	-	Air-flow sensor potentiometer signal	17 - 2	Control unit connected. Switch on ignition. Deflect sensor plate by hand. Voltage rise from 0 to max. 8.0 V	0 ... 8.0 V

Rapid diagnosis chart for universal test adapter ETT 018.01 (continued)

Test Step	Switch Position V	Switch Position Ω	Button	Under Test	Test Connections	Test Conditions	Test Specifications (Reading)
16	9	-	-	Throttle-valve switch power supply	6 - 2	Control unit connected. Switch on ignition.	7.0...8.0 V
17	-	-	1	Warm-up enrichment -20°C	12 - 12	Control unit connected. Switch on ignition.	40 ... 60 mA
18	-	-	2	Actuator current, corresponding to engine at normal op. temp.	12 - 12	Control unit connected. Switch on ignition.	0 ... 1 mA
19	-	-	4	Starting enrichment	12 - 12	Control unit connected. Switch on ignition. Test specification must be obtained while pressing button.	130...150 mA
20	-	-	1/4	Post-start enrichment	12 - 12	Control unit connected. Switch on ignition. Keep button 1 pressed: Press button 4: After releasing button 4, test specification briefly remains steady and is then slowly cut back to:	40 ... 60 mA 80 ... 120 mA 40 ... 60 mA

Rapid diagnosis chart for universal test adapter ETT 018.01 (continued)

Test Step	Switch Position V	Switch Position Ω	Button	Under Test	Test Connections	Test Conditions	Test Specifications (Reading)
21	-	-	1/6	Acceleration enrichment	12 - 12	Control unit connected. Switch on ignition. Keep both buttons pressed. Current: Then deflect sensor plate. Current rises (130...150mA) and is cut back again very quickly.	40 ... 60 mA 130 ... 150 mA
22	-	-	6	Full-load enrichment	12 - 12	Control unit connected. Start engine and hold engine speed at 1800 min $^{-1}$.	4.5...7.5 mA
23	-	-	2	Overrun cutoff	12 - 12	Control unit connected. Start engine. Reverse polarity of ammeter (swap + and -). While pressing button, hold engine speed at approx. 1400...1500 min^{-1} and operate idle throttle-valve switch by hand. Engine hunts. The test specification (-40...-50 mA) is indicated with dropping engine speed.	-40...-50 mA



4. Electrical terminal diagram with electric fuel pump safety circuit

1 = Air-flow sensor potentiometer
2 = Electronic relay with overvoltage protection
3 = Electronic relay for energization of electric fuel pump and start valve
4 = EGR control unit
5 = KE-Jetronic control unit
6 = Throttle-valve switch (microswitch on linkage)
7 = Double throttle-valve switch
8 = Electro-hydraulic pressure actuator
9 = Double temperature sensor
10 = Start valve
11 = Auxiliary-air device
12 = Electric fuel pump
13 = EGR solenoid-operated valve
a = Terminal 30, central-electrics box
b = Terminal 15, central-electrics box, connector U, socket 5
c = Terminal 50, engine cable connector
d = Terminal TD ignition, diagnostic socket cable connector
e = Terminal 30, engine cable connector
f = Engine cable set connector
g = Engine cable set connector
h = Terminal 15, passenger-compartment cable connector
M1 = Battery ground
M2 = Engine ground
M3 = Luggage-compartment ground, wheel housing, left

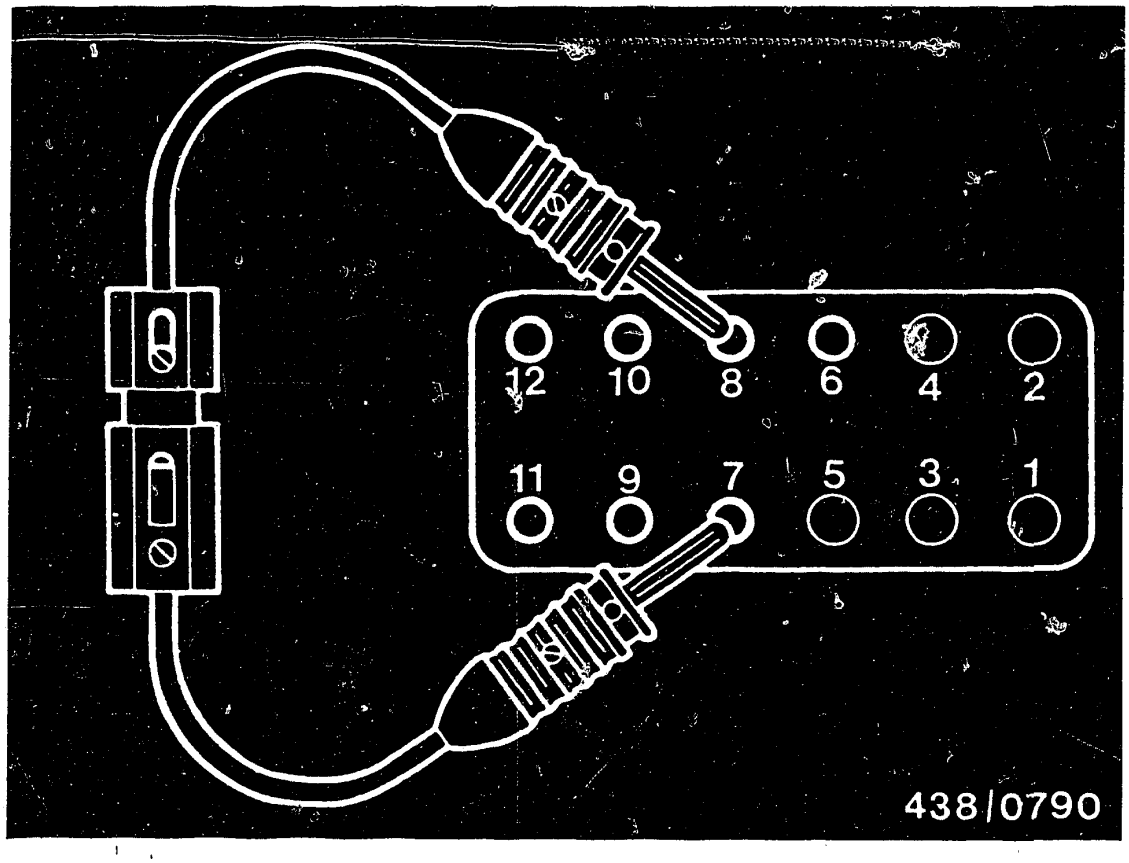
4.1 Jumping the electrical safety circuit

For all pressure and fuel-delivery tests, it is necessary to jump the electrical safety circuit for electric fuel pump and auxiliary-air device.

The electronic engine-speed relay, together with the EGR control unit and the overvoltage-protection relay, is on the right-hand side (as viewed in the forward direction of travel) next to the KE-Jetronic control unit (protected equipment space behind the battery).

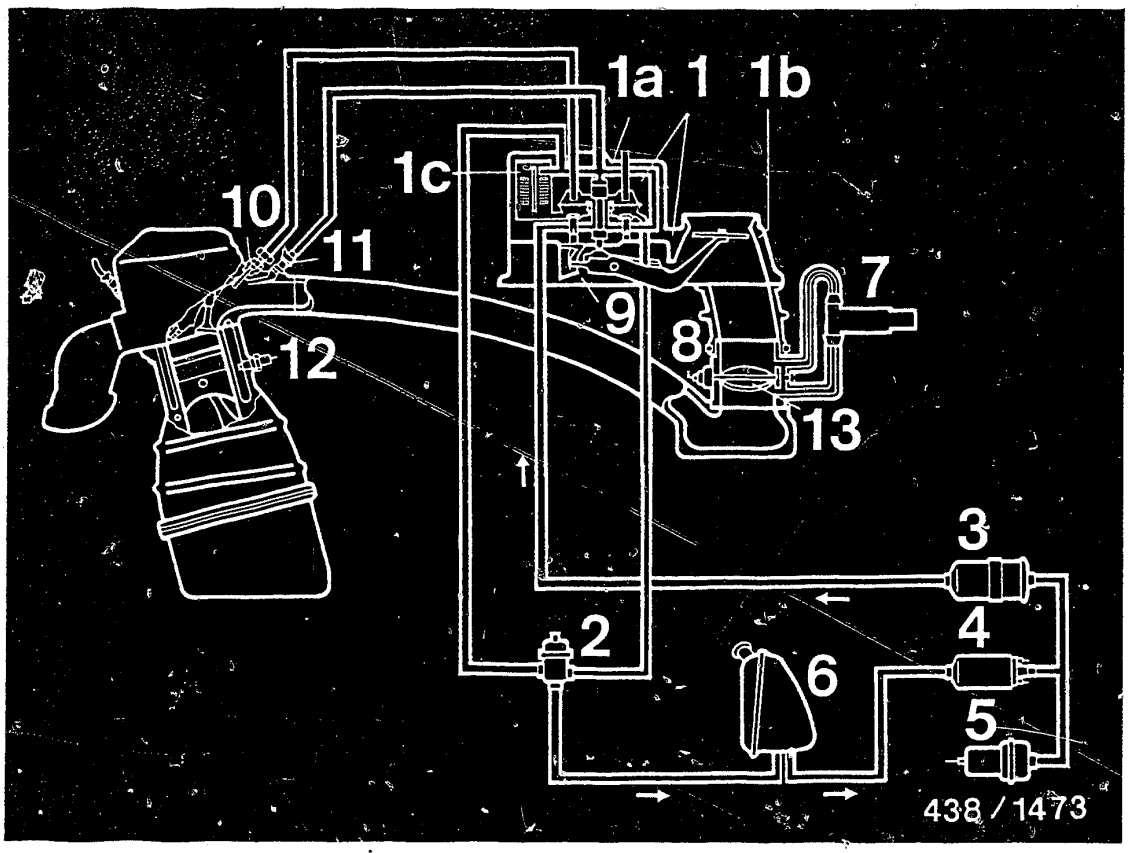
Important:

To test the control-unit functions, it is sufficient to switch on the ignition. The safety circuit must not be jumped. This ensures that, when the air-flow sensor plate is moved, no fuel is injected. This would lead to serious engine damage when the starting motor is subsequently operated.



Bridge pins 7 (87) and 8 (30) in the relay base using connecting cable. Use connecting cable 1.5 mm² with fuse holder and 16 A fuse (to be user-fabricated as per sketch).

The electric fuel pump and auxiliary-air device are now supplied with battery voltage.



5. Diagram of fuel lines

1 = Mixture-control unit
1a = Fuel distributor
1b = Air-flow sensor
1c = Electrohydraulic pressure actuator
2 = Pressure regulator (primary pressure)
3 = Fuel filter
4 = Electric fuel pump
5 = Fuel accumulator
6 = Fuel tank
7 = Auxiliary-air device
8 = Full-load throttle-valve switch
9 = Air-flow sensor potentiometer
10 = Injection valve
11 = Start valve
12 = Temperature sensor (NTC)
13 = Throttle valve

6. Installation position of components

The installation position of the KE-Jetronic components is described on microcard MB 501. There are the following differences:

The electronic engine-speed relay and the overvoltage-protection relay are on the right-hand side (as viewed in the forward direction of travel) next to the KE-Jetronic control unit.

The components of the emission-control system are described in a separate section (starting on Coordinate B 1).

7. Emission-control system; functional description

The emission-control system consists of two separate systems:

Secondary-air self-induction

Exhaust-gas recirculation

The possible influence of these two additional systems should be borne in mind when conducting trouble-shooting on the mixture-preparation system.

7.1 Secondary-air self-induction:

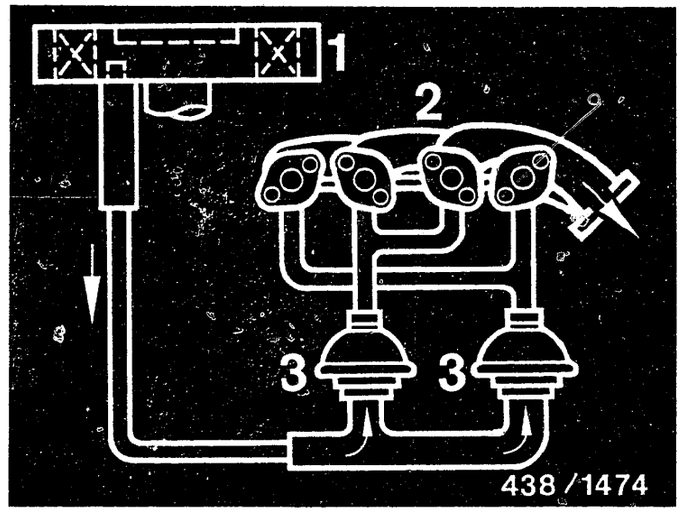
Situated on the undersides of the 4 ports of the exhaust manifold (2) are fittings which are connected by distributor pipes to 2 non-return valves (3). From the non-return valves, a hose line leads to the outlet side of the intake air filter (1).

The high flow velocity of the exhaust gases in the exhaust manifold and the pulsation (pressure oscillations) cause an alternation of overpressure and vacuum in the distributor pipes.

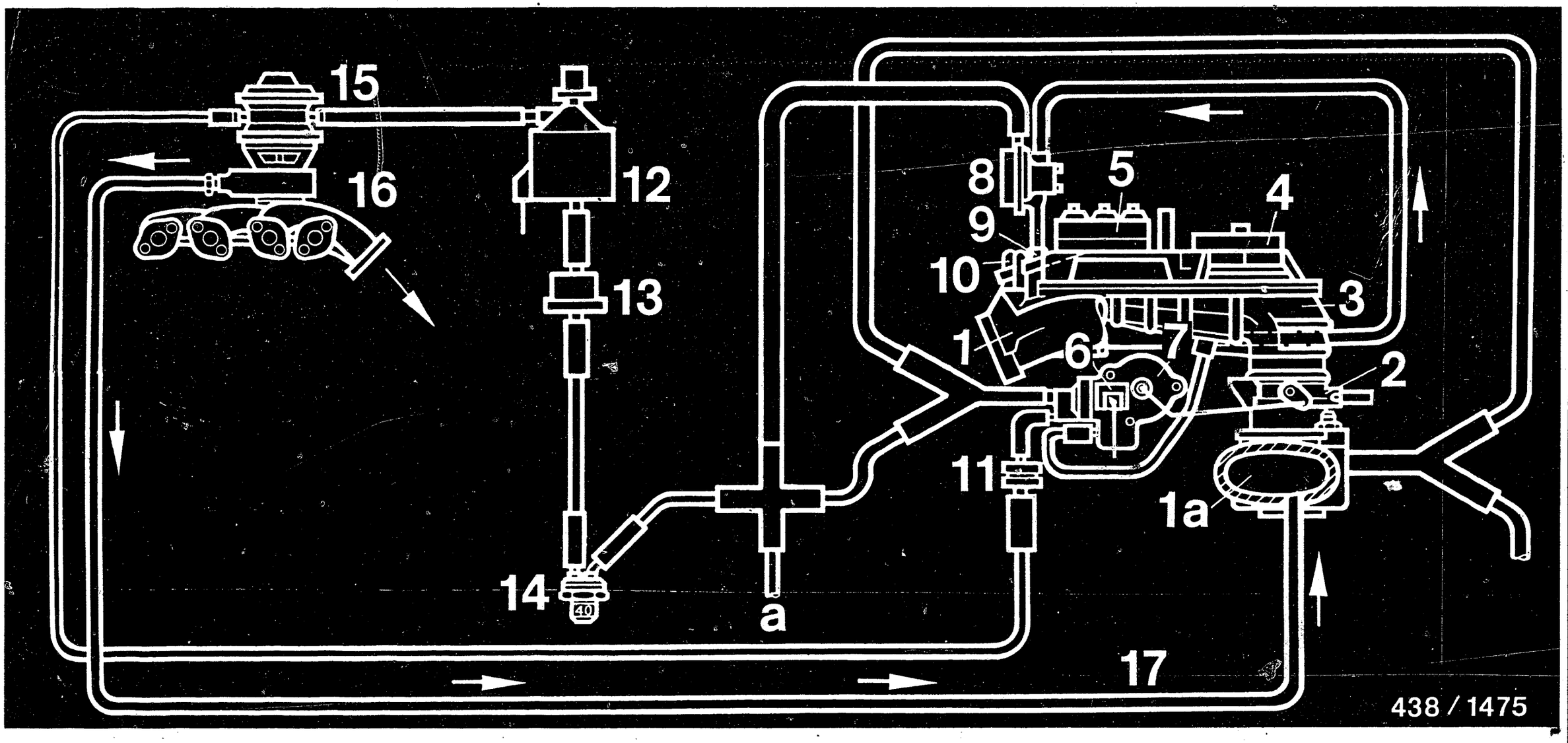
During the vacuum phases, the non-return valves open and fresh air flows into the exhaust manifold. This adding of oxygen leads to the afterburning of incompletely combusted components in the exhaust gas and thus to a reduction in pollutants. During the overpressure phases, the non-return valves are closed.

Note: The secondary-air self-induction system remains in operation for adjusting the idle (CO checking and adjustment).

The trouble-shooting on this system is limited to a visual examination of all lines and connections.



1 = Intake-air filter
2 = Exhaust manifold
3 = Non-return valves



7.2 Exhaust-gas recirculation

● Basic diagram of exhaust-gas recirculation (EGR)

1 = Intake-manifold top part
1a = Intake-manifold bottom part
2 = Throttle-valve assembly
3 = Air-guide housing
4 = Air-flow sensor
5 = Fuel distributor
6 = Throttle-valve switch
7 = Vacuum-control valve
8 = Overrun bypass-air valve (only on vehicles with manual transmission)
9 = Specially shaped hose
10 = Idle-air distributor
11 = Vacuum damper with restriction
12 = EGR solenoid-op.valve
13 = Vacuum non-return valve
14 = Thermo-valve +40°C
15 = EGR valve
16 = Exhaust manifold
17 = EGR line
a = Ignition advance

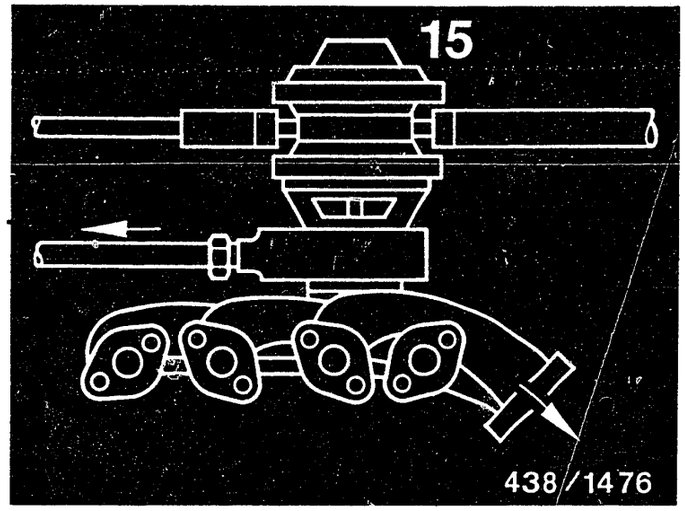
7.3 System description

With exhaust-gas recirculation, under certain engine operating conditions, some of the exhaust gas is recirculated to the intake and takes part again in combustion. The recirculation of exhaust gas to the combustion chamber lowers the peak combustion temperatures, thus reducing the emission of oxides of nitrogen (NO_x).

The quantity of recirculated exhaust gas is varied or suppressed entirely, depending on the operating state of the engine.

Exhaust-gas recirculation takes place:

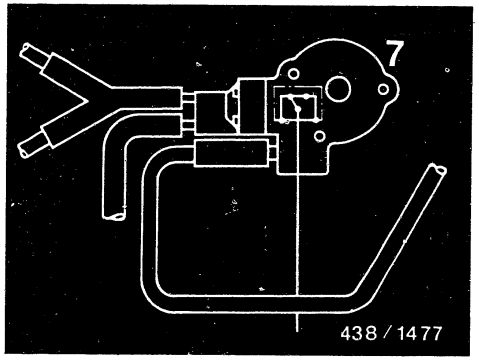
- Above +40°C engine temperature
- At part load (throttle-valve position approx. 4° above idle position to approx. 10° before full-load position)
- Within the part-load range the quantity of exhaust gas is determined as a function of intake-manifold vacuum and throttle position.



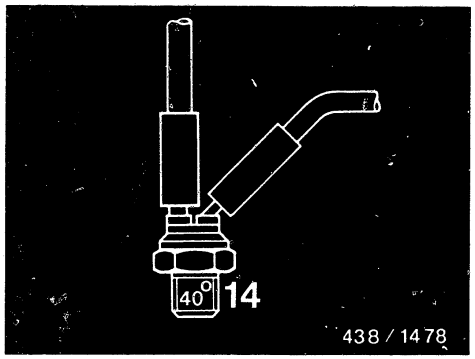
7.4 Description of components:

The exhaust gas recirculation valve (EGR valve) (15) is flanged onto the exhaust manifold. It determines the quantity of recirculated exhaust gas as a function of the vacuum applied.

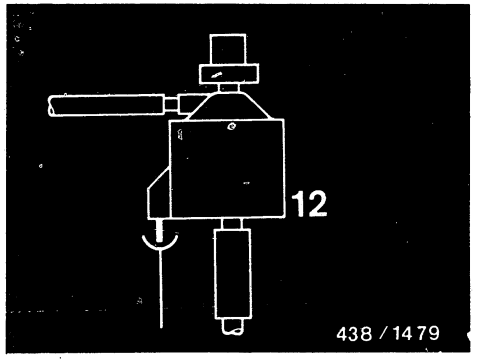
The vacuum-control valve (7) forms one structural unit with the throttle-valve assembly. The movement of the throttle valve is transmitted by a pressure rod to the control valve. The control valve determines the vacuum applied to the EGR valve, depending on the throttle position, and thus determines the quantity of exhaust gas recirculated.



The thermo-valve (14) is connected into the vacuum-control line to the EGR valve. It is closed at coolant temperatures below +40°C and allows the recirculation of exhaust gas only above this temperature.

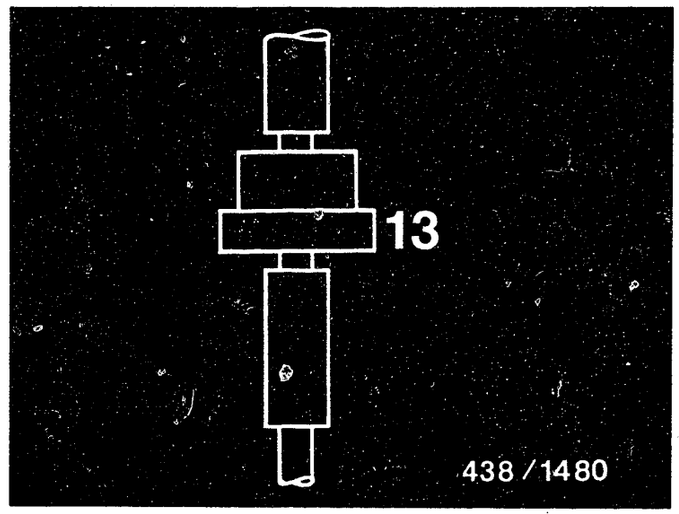


The EGR solenoid-operated valve (12) is likewise connected into the vacuum-control line. Electrical energization is by means of the EGR control unit, as a function of the throttle position. When de-energized, the passage for vacuum is open. When energized, the valve switches to atmospheric pressure and the vacuum to the EGR valve is discontinued.

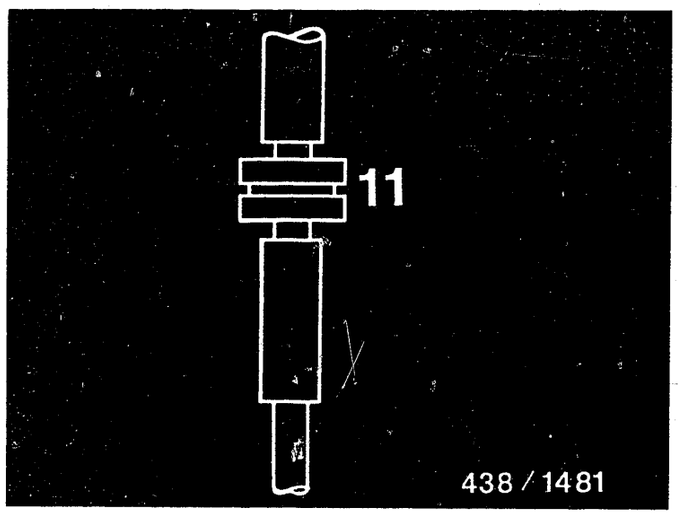


The idle/full-load throttle-valve switch (6) is mounted on the vacuum-control valve (7) and, by way of the EGR control unit, determines the switching of the EGR solenoid-operated valve. The idle contact is closed at idle and opens at approx. 4° throttle-valve opening. The full-load contact closes approx. 10° before the full-load position.

A non-return valve (13) in the vacuum-control line to the EGR valve ensures that the vacuum applied to the EGR valve is maintained with increasing opening of the throttle valve.

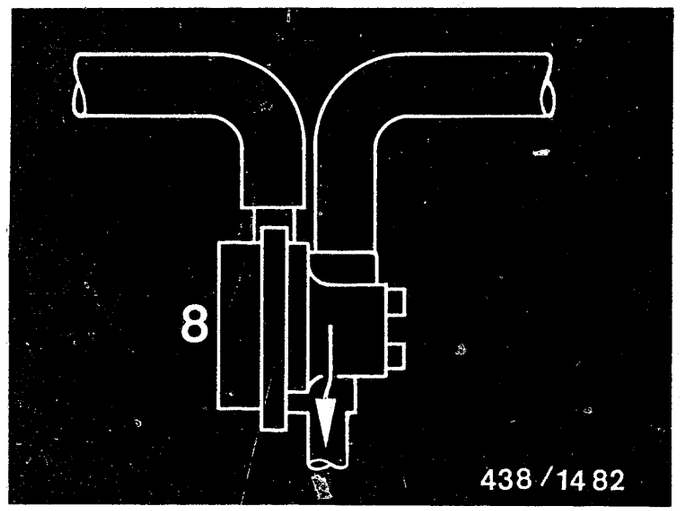


A vacuum damper with restriction (11) is situated in an additional air line between the vacuum-control valve and the EGR valve. This restriction damps the switching operations of the EGR valve if the accelerator is operated quickly.

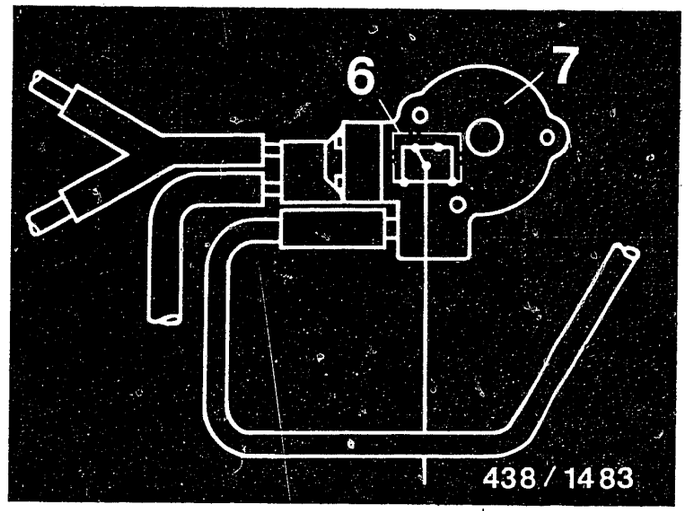


Vehicles with manual transmission are equipped with an overrun bypass-air valve (8) (near ignition distributor). It works as a vacuum-controlled auxiliary-air valve which opens on overrun and thus supplies additional air to the engine by bypassing the closed throttle valve. Combustion on overrun is stabilized, thus reducing the emission of hydrocarbons.

Due to its design, the valve is closed when the engine is stopped. After the engine is started, the valve opens briefly until, by means of an internal restriction, there is pressure equalization on both sides of the working diaphragm. This briefly raises the idle speed after starting and stabilizes idling.



7.5 Testing the exhaust-gas recirculation system



Note on trouble-shooting:
If a fault is found in one of the following tests, it must be rectified and the test step must be repeated.

Test step 1

Check vacuum-control valve (7):
Disconnect vacuum line (white/brown) from EGR valve. Connect vacuum tester (e.g. Mityvac vacuum pump) to line (white/brown).
Engine idling.
Vacuum should be above 160 mbar.

O.K.?

no → Replace vacuum-control valve (7) complete with throttle-valve assembly, throttle-valve switch and vacuum damper with restriction.

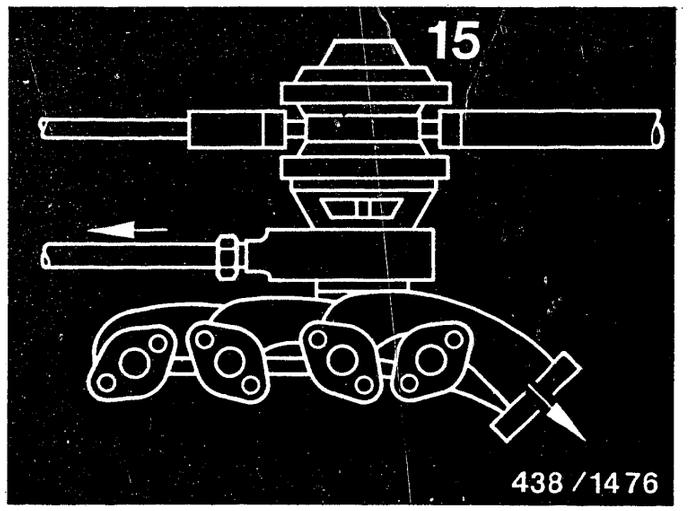
yes ↓

Test step 2

Check operation of EGR system:
Disconnect vacuum line (white/brown) from EGR valve (15).
Start engine and slowly raise engine speed.
Does engine run irregularly or stall as of approx. 1000 min^{-1}?

no → Continue testing with test step 3

yes ↓



Test step 3

Check vacuum lines:
Are the vacuum lines correctly connected and leak-tight?

no → Check the layout and leak-tightness of the vacuum lines in accordance with the basic diagram of the EGR system, and rectify any faults.

yes ↓

Test step 4

Check EGR valve (15):
Disconnect both vacuum lines from EGR valve. Connect EGR valve (red port) and 3-way distributor (arrow top diagram) using user-fabricated vacuum line.

Does idle speed drop and does engine run irregularly or stall?

no → Replace EGR valve.

yes ↓

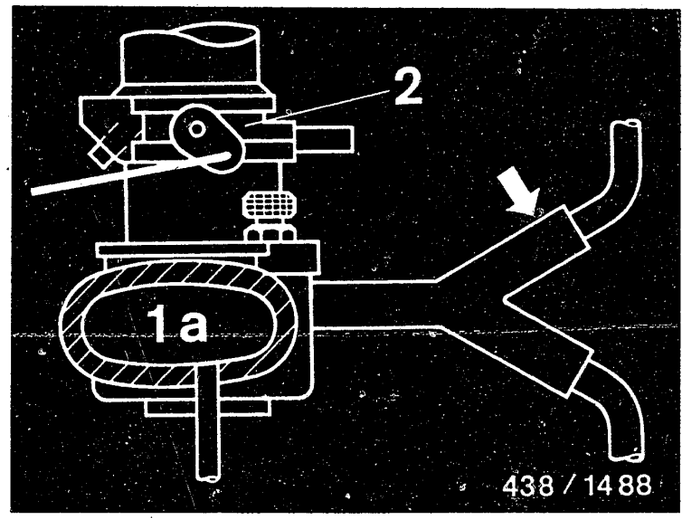
Test step 5

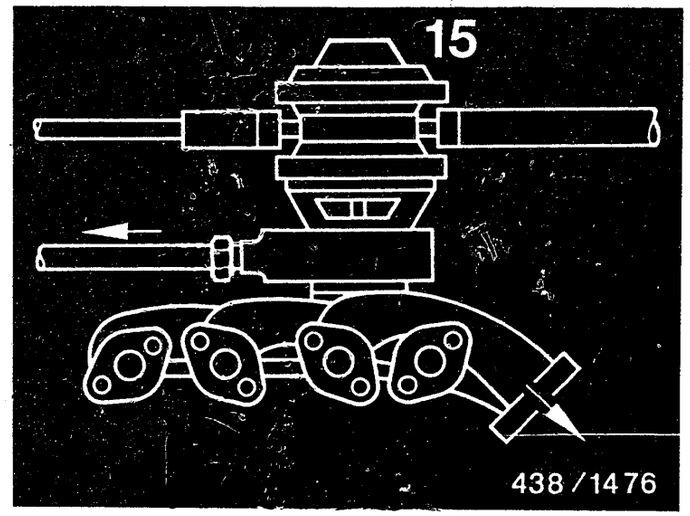
Check non-return valve (13):
Using vacuum tester (e.g. Mityvac vacuum pump), check non-return valve for leaks (black to blue direction) and throughflow (blue to black direction).

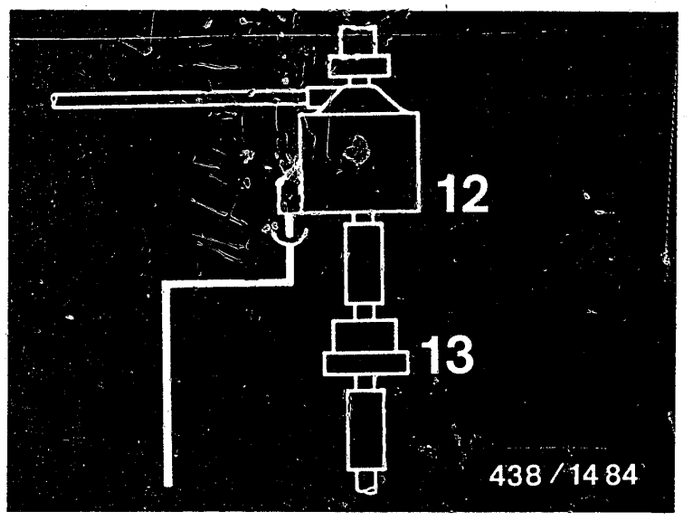
Is non-return valve leak-tight in the one direction and does it permit throughflow in the other?

no → Replace non-return valve.

yes ↓







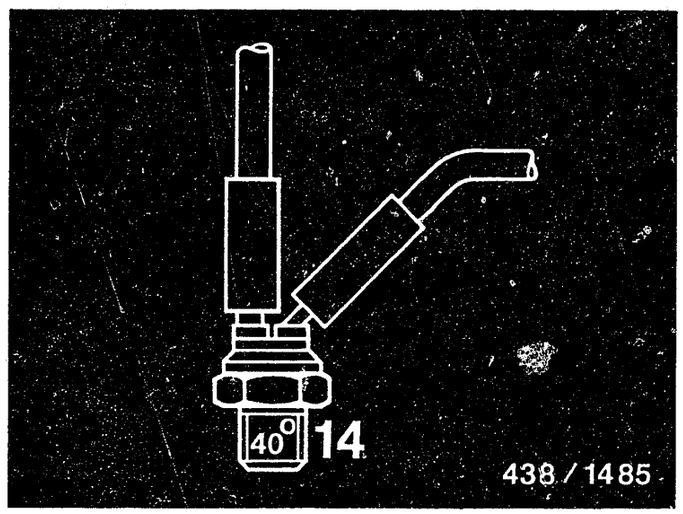
Test step 6

Check thermo-valve 40°C (14):

Disconnect vacuum line (white/violet/brown) from the straight fitting on the thermo-valve and connect vacuum tester (e.g. Mityvac vacuum pump) to thermo-valve.
Start engine and warm up.

Vacuum present?

no → Replace thermo-valve.



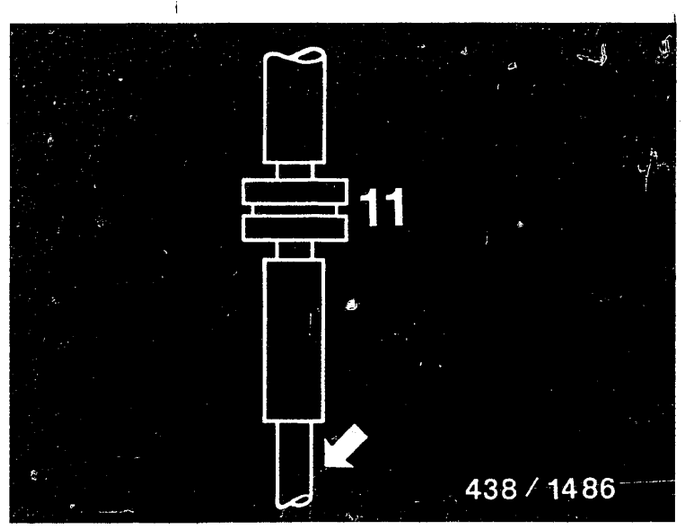
yes

Test step 7

Check vacuum damper (11) with restriction:
Start engine.
Disconnect vacuum line (white/brown, arrow) and connect vacuum tester (e.g. Mityvac vacuum pump) to vacuum damper.

Vacuum present?

no → Check restriction for free passage, blowing through if necessary.



yes

Test step 8

Check power supply to EGR control unit:
Disconnect EGR control unit.
Connect voltmeter to socket 9 (positive) and socket 11 (ground).
Switch on ignition.

Voltage of 8 ... 15 V obtained?

no → Check positive lead (black) and ground lead according to electrical terminal diagram.
Rectify faults.

yes ↓

Test step 9

Check cable set to soleonoid-operated valve:
Disconnect EGR control unit.
Connect sockets 9 and 3 together.
Disconnect coupling from EGR solenoid-operated valve and connect voltmeter.
Switch on igntion.

Voltage of 8 ... 15 V obtained?

no → Check positive lead (black) and ground lead according to electrical terminal diagram.
Rectify faults.

yes ↓

Test step 10

Check EGR solenoid-operated valve:

At idle, disconnect coupling from EGR solenoid-operated valve and connect again.

Switching of EGR solenoid-operated valve noticeable?

no → Replace EGR solenoid-operated valve.

yes ↓

Test step 11

Check cable set to throttle-valve switch:
Disconnect control unit.
Take apart triple connector (near mixture-control unit) between throttle-valve switch and EGR control unit. Switch on ignition.

a) Connect sockets 1 and 2 of triple connector. Connect voltmeter to sockets 10 (positive) and 11 (ground) on base of EGR control unit.
Specification 8 ... 15 V.

b) Connect sockets 2 and 3 of triple connector.
Connect voltmeter to sockets 8 (positive) and 11 (ground) on base of EGR control unit.
Specification 8 ... 15 V.

Both voltage specifications obtained?

no → Check cable set to throttle-valve switch according to electrical terminal diagram.
Rectify faults.

yes ↓

Test step 12

Check throttle-valve switch:
Take apart triple connector (near mixture-control unit) between throttle-valve switch and EGR control unit.

a) Connect ohmmeter to pins 1 and 2.
Resistance specification, throttle valve closed: 0 ... 1Ω.
Resistance specification, throttle valve in part-load position: Ω.
Switching point: gap between throttle lever and stop screw = 1 ... 1.3 mm.

b) Connect ohmmeter to pins 2 and 3.
Resistance specification, throttle valve wide open: 0 ... 1Ω.
Readings and switching point O.K.?

no → Adjust throttle-valve switch by turning in the region of the fastening-screw slots, or replace defective throttle-valve switch.

yes ↓

Test step 13

Check EGR control unit:
Disconnect coupling from EGR solenoid-operated valve.
Connect voltmeter to coupling.
Switch on ignition.
Throttle valve closed/wide open:
Specification 8 ... 15 V.
Throttle valve slightly open:
specification 0 V.
Voltage specifications obtained?

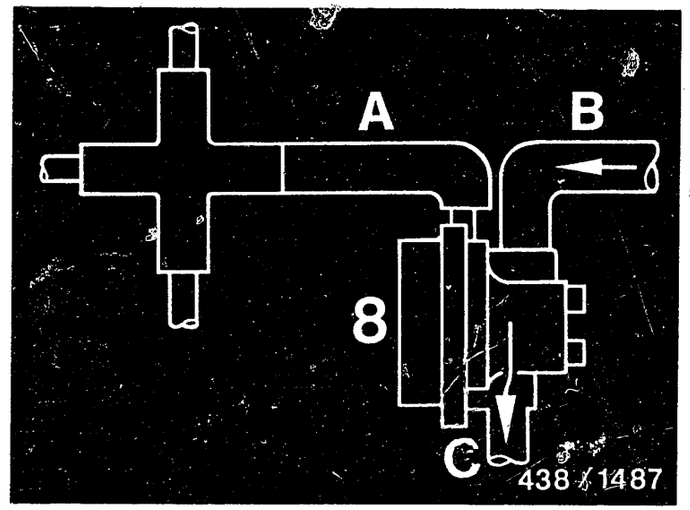
no → Replace EGR control unit.

yes ↓

Test step 14

Check hose lines to overrun bypass-air valve:
(Only on vehicles with manual transmission)
Layout and leak-tightness of hose line (B) from specially shaped hose to overrun bypass-air valve and hose line (C) from overrun bypass-air valve to specially shaped hose between auxiliary-air distributor and idle-air distributor O.K.?

no → Check layout and leak-tightness of hose lines (B + C).



yes ↓

Test step 15

Check overrun bypass-air valve (8):
(only on vehicles with manual transmission)
Start engine.
Disconnect 4-way distributor from overrun bypass-air valve and seal off with finger (A).
After approx. 10 sec. re-connect 4-way distributor.

Does idle speed increase briefly?

no → Replace overrun bypass-air valve.

yes ↓

End of test

Published by:
After-Sales Service Department for Training and Technology (KH/VSK). Press date: 1.1986